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(6) When the reaction of acidified toxin is brought back to neutral (before dilution), the resulting solution has the titer of the original toxin. The re-acidification and re-neutralization can be accomplished several times in succession with the result that acidification invariably increases the potency and neutralization returns it to the original titer.

(7) When one cubic centimeter of the original toxin has been distributed through a sufficiently large amount of a diluent so that not every cubic centimeter of the diluent would be theoretically expected to contain one molecule of original toxin, the results of the injection of such highly diluted toxin become irregular and apparently depend on the presence or absence of a molecule or a small number of molecules of toxin in each portion injected.

(3) While not every filtrate yielded an equally potent product on acidification, the same filtrate consistently titrated as indicated, even though repeated tests were performed several days and weeks apart.

On the other hand, it is evident that there are a number of considerations militating against the validity of our observations.

(1) Using the same strain of the organism and similar culture medium, it was not always possible to obtain the same degree of increase in potency of the acidified filtrates, although in all cases some increase was observed. Apparently, the uncontrollable differences in composition of the culture medium during the early growth of the organism has something to do with the degree of change in potency which the toxin will undergo upon its subsequent acidification.

(2) It is difficult to conceive how such a small number of molecules which can theoretically be expected to be present in the small amount of toxin injected can produce the effect.

(3) The extreme simplicity and low molecular weight which the active substance seems to possess according to calculation is difficult to reconcile with its strict biologic specificity which would postulate a more complex structure.

(4) We find that while this active toxin is neutralized by a specific antitoxin, the neutralization does not go according to the law of multiple proportions, but is in fact more efficient.

(5) It is difficult to explain why such a simple molecule as that which the active toxin seems to possess can not pass bacterial filters which are comparatively permeable to the original toxin.

These, as well as other considerations, indicate that a further study of the subject is necessary. We feel more inclined to believe, and some of our most recent observations strengthen this belief, that while the toxin does unquestionably undergo an increase of potency under certain conditions of the experiment, the degree of this increase probably is not as great as some of our findings seem to indicate. We suspect that there may occur an ultramicroscopic precipitation of the toxin-carrying portion of the medium. If the minute particles of such a precipitate should possess particularly high adsorptive power, they could be carried from dilution to dilution and thus vitiate the accuracy of the calculation. Since circumstances force us to interrupt this study for the time being, we thought it worth while to call the attention of other workers to this interesting phenomenon. With this in view, we are preparing detailed protocols of the experiments to date which we hope to publish in the near future.

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SOIL SHIFTING IN THE CONNECTICUT VALLEY

RECENTLY two articles have appeared in the current volume of SCIENCE (Nos. 1413 and 1426), reporting soil shifting by wind. In the Connecticut Valley in the vicinity of Amherst sand storms are a common occurrence. The prevailing winds, coming from the northwest, have a rather uninterrupted sweep down the valley, and at times pick up and transport large quantities of soil consisting of sands, sandy loams, silt loams, clay loams and clays. It is the coarser members of the above soils that are most eroded because the heavier soils are usually covered with vegetation.

This shifting of the soil by wind action has

no doubt had an important part in shaping the topography of the region, which may be described as the level to rolling bottom of an ancient lake or arm of the sea dotted with sandy knolls or modified sand dunes. The shifting also presents to the farmers of the section some problems of soil management.

Probably the most striking instance in recent years of wind erosion of soils in this vicinity occurred on the days of April 27 to 30, 1922. Observations by the writer showed a drift as deep as three inches, the deepest observed being on the south sides of tobacco barns. Onion seeds were blown out of the soil necessitating in some cases reseeding, and no doubt many tons of fertilizer were carried from recently fertilized onion fields on which a first application of one ton of high grade fertilizer is the common practice. It was observed that any sort of a ground covering, even loose tobacco stalks, was rather effective in checking erosion, but a growing cover crop as commonly used in tobacco, but not onion, fields was most effective.

The winds most disastrous from the standpoint of soil erosion are those of two or more days' duration, the first day usually being required to dry the soil. Although sandstorms may occur frequently during the year, the most damage is done in the spring when the land is being or has been recently prepared for crops.

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SCIENTIFIC BOOKS

Development and Activities of the Roots of Crop Plants: A Study in Crop Ecology. By JOHN E. WEAVER, FRANK C. JEAN and JOHN W. CRIST. 17 x 25 cm., VI + 117 pages, 42 figures, 14 plates. Carnegie Inst. Washington, Publ. no. 316. May 11, 1922.

STUDENTS of plants, especially in physiology, ecology and agriculture, will be interested in Weaver, Jean and Crist's book on the roots of crop plants, in which is brought forth a mass of detailed information in a field that has been largely neglected until recently. The studies now reported are a continuation of those presented in Weaver's "Root Development in the Grassland Formation" (1920). Much of the present work follows the methods of his earlier investigations on the form and distribution of the root systems of uncultivated plants. The descriptive data are obtained by what must seem to most botanists very tedious and laborious excavations; each root is traced to its end and the size, form, etc., of the whole root system of each plant is shown diagrammatically on a chart. The published charts frequently show the size of the top, as well as the depth and spread of the root system and the number of roots. Root systems of plants growing under field conditions are described, in several stages of their development, for Lincoln and Peru, Nebraska, for Phillipsburg, Kansas, and for Burlington, Colorado, these stations having mean annual precipitations of about 33, 28, 23 and 17 inches, respectively. The plants dealt with are: oats, wheat, barley, maize, potato, alfalfa and sweet clover, for the seasons of 1919, 1920 and 1921. Some excellent experimental studies bearing on the soil-depths from which water and nitrate were removed during several developmental stages of the plants are considered in the final chapter of the book.

It is pointed out that the root systems of crop plants show modes of growth similar to those of native plants growing in the same region, both being apparently influenced by the environmental moisture conditions. With higher evaporation intensities and drier surface soils the root systems tend to be developed less extensively in the superficial soil layers and they extend farther into the deeper layers. There are some differences between the different forms of plants, but all the forms studied usually have, at the approach of maturity, a set of roots that ramify laterally in the upper 30 or 40 cm. of soil, and a set that reach downward, with more or less profuse branching, to depths of from 1 to nearly 3 m. The two portions of the root system may be relatively distinct or they may be nearly continuous. The deepest soil layers reached are of course not generally well occupied by branches.

The authors emphasize the fact that the roots of crop plants usually penetrate and